



Ø BEAT



COLO. SPRINGS,
COLORADO

APRIL 1980

dB or not dB — That is the question

What do the letters DB stand for? Sooner or later anyone working with radios will run across the term and get confused. DB stands for decibel a unit to describe a **power ratio**. Notice the word power is in bold, this is important because the decibel is *always* a power ratio although it may be expressed in terms of voltage or current with proper precautions.

The decibel is one-tenth of a Bel, the basic unit, however the Bel is seldom used so we will confine our discussion to the decibel. The decibel as we stated is a power ratio expressed in logarithmic form. On a logarithmic scale 0 equals 1, 10 equals 10, 20 equals 100, 30 equals 1000 and so on. Showing this relationship in table form will make it a little clearer.

Decibels		Numerical Equivalent
- 60	=	1/1,000,000
- 30	=	1/1,000
- 20	=	1/100
- 10	=	1/10
0	=	1
10	=	10
20	=	100
30	=	1000
60	=	1,000,000
100	=	10,000,000,000

When working with decibels remember what you really are working with is a **power ratio**. As an example let's take an amplifier with a gain of 30dB, the question is "how much does the amplifier increase the level?" Looking at the table above locate 30 dB. The increase in level is equivalent to the numerical value of 30 dB or 1000. The table can also be used for a loss in dB ie -30 dB. Such a case would be an attenuator. In this case the attenuator would have an output equal to 1/1000th of the input. Notice so far we have only talked about a ratio, not absolute values.

In many applications some standard reference has been agreed upon. In audio and radio frequency work this reference is usually 1 milliwatt. In antenna work we use either an isotro-

pic source or a dipole. Sometimes, when working with relatively high power such as those encountered in transmitters, the reference level will be 1 watt. To prevent confusion we add a letter to dB to indicate the reference level.

dBm	decibel compared to a milliwatt
dBw	decibel compared to a watt
dBd	decibel compared to a dipole
dbi	decibel compared to an isotropic source

Let's look at another example: an antenna has a 20 dBi gain, what is the effective power gain of the antenna? Looking at the dB table we find 20 dB equals a ratio of 100. The dBi indicates we were referencing to an isotropic radiator.

The table shows many of the commonly used ratios but what happens if we have 3, 9, 14, 33 or any other dB ratio? What follows is an easy to use technique to make a very close approximation of any dB ratio mentally. First there are two basic ratios that must be committed to memory:

3 dB = a power ratio of 2

10 dB = a power ratio of 10

With only these two ratios all the other whole number dB ratios can be mentally computed. The technique is simple, just add positive dBs, subtract negative dBs to get the total gain or loss in decibels. Here is an example:

+10 dB

+ 3 dB

+13 dB

To find the numerical power ratio of 13 dB simply multiply or divide the equivalent numerical ratios:

+10 dB = 10

+ 3 dB = $\times 2$

+13 dB = 20

therefore +13 dB equals a power ratio of 20. Here is a couple of more examples:

+10 dB = 10

- 3 dB = $\div 2$

+ 7 dB = 5

+ 3 dB = 2

+ 3 dB = $\times 2$

+ 6 dB = 4

Continued on page 3

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(* Two-year board terms began November 1979)

ZERO BEAT is published monthly in the interest of the members of the Pikes Peak Radio Amateur Association, Inc., Colorado Springs, CO. Permission is given to reprint articles or excerpts provided credit is given. Deadline for submission of articles to be published is the third week of the month. Classifieds accepted anytime.

The Pikes Peak Radio Amateur Association meets on the second Wednesday of every month at Sabin Jr. High School, 3605 N. Carefree Circle at 7:30 p.m. and all amateurs and interested persons are cordially invited. The Association also conducts an informal net on all Wednesday evenings, except meeting night, on 146.52 MHz FM at 7:00 p.m.

Editor: Jim Colvin NØAVY, 4610 Topaz, Colorado Springs, CO 80918 598-7704

MEETING MINUTES

The March meeting of the PPRAA was called to order at 7:34 P.M. March 12, 1980 by Don Lohse KBØKQ, President.

The treasurer's report was given by Dave WBØSDW with \$309.00 and \$77.50 in SERVCOM.

Gary Palmgren from the Colorado Motorcycle Trailriders Association thanked the club for providing communications for the Pikes Peak Enduro, and told us that the next Enduro will be coming up possibly the 3rd week in September.

Ken KAØDST announced that the Swap Fest will be held in Hanger No. 8 at Pete Field on Sunday April 13 from 10 a.m. to 4 p.m. Frank WBØPAJ will take care of radio and TV advertising. Chuck WØRNT will send flyers to the CCARC clubs. Oak KØROL will supply the PA system, with Dick WBØPNX on voice. Jim NØAVY and Charleen WBØYOB will provide tables.

The new address of the FCC is 12477 W. Cedar, Lakewood, CO.

The Mall Demonstration will be May 3 and 4 at the Mall of the Bluffs and is still in the planning stage. We want as many modes of Amateur Radio as possible on display.

The Board meeting will be at the home of Dave WBØSDW on April 7 at 7:30 P.M.

Frank WBØPAJ has no news from the OTC.

Don KBØKQ requested that all articles for ØBeat be in by meeting night or very shortly afterwards. Don also said that you will not receive Ø Beat unless your membership has been received.

WBØLTV, Smitty, mentioned that we should check into incorporation, and a permit for mailing for non-profit organizations.

Lee, KBØHW suggested that we send renewal notices to people who have not sent dues in.

Ray, AAØL, reported that the transmitter hunt was a great success with ten cars participating and everyone wanting to do it again.

Dave NØDV, Field Day Chairman, is planning for the event which will take place the 3rd weekend in June. The location will be on the Rampart Range Road about 5 miles north of Woodland Park. Dave would like to have 1 person in charge of each station, 1 person on generators, 1 for food, and 1 for novices.

The May program will be Dick Ehrhorn, "State of the Art of Amplifiers." The program will be geared to home brew. Ehrhorn is looking for a technician to build and demonstrate amplifiers.

Chuck WØRNT had several things from CCARC. The next meeting will be April 19. The N. Colorado Amateur Radio Club will sponsor Super Fest No. 2 on June 7th. The Denver Radio Club is proposing a regional convention in July. CCARC has a repeater directory available.

The Channel 9 Health Fair on April 15 and 16 will have exhibits and tests available for the public at the Community College and the Acacia Hotel, and may want Ham Communications.

Ed Means WØVO reported from AMSAT that Oscar Phase III will be launched May 23rd from French Borneo. The launch window will be 8 a.m. 'til 11 a.m. There will be bulleti stations on all H.F. Bands starting 2 weeks before launch until 2 weeks after launch. AMSAT needs contributions of parts (High Q or high reliability) and money contributions. Memberships are \$10.00 per year or \$100.00 for life, and as of July those fees will double. Ed asked that the club consider a contribution to AMSAT.

Hammy, the Ham of the Month Award, was given to Al ADØZ, Jim NØAVY, and Warren WBØSJR for teaching the Novice classes.

Volunteers are needed for the 52 Net every Wednesday night.

Volunteers are needed for refreshments.

New Business: Hams who live in the Country Club Mobile Home Park please contact Dave WBØSDW regarding antennas in that area.

Greg WB2OOD had a VTVM available at \$20.00.

Please donate baked goods for the bake sale at the Swap Fest.

The program was given by Jerry Murphy on Radio Control.

Respectfully Submitted,
Lorna WDØBTF

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"DB OR NOT DB, THAT IS THE QUESTION."

... (cont.)

Remember, to compute the numerical power ratio of several dB ratios, add or subtract the dBs and multiply or divide the numerical values.

I said you could figure out any whole number dB ratio from just the two basic ratios ie 3 dB = 2 and 10 dB = 10. The method involves additions and subtractions of these two known quantities. For example 9 dB is really 3 dB + 3 dB + 3 dB. We add dBs and multiply numerical values so $2 \times 2 \times 2 = 8$. 9 dB is equivalent to a numerical value of 8. Here are a few more examples:

What is the numerical ratio of 1 dB?

$$10 \text{ dB} - 3 \text{ dB} - 3 \text{ dB} - 3 \text{ dB} = 1 \text{ dB}$$

$$+10 \text{ dB} = 10 \quad 10 \div 2 = 5 \quad 5 \div 2 = 2.5 \quad 2.5 \div 2 = 1.25$$

$$- 3 \text{ dB} = \div 2$$

$$- 3 \text{ dB} = \div 2$$

$$- 3 \text{ dB} = \div 2$$

$$1 \text{ dB} = 1.25$$

What is the numerical ratio of 26 dB?

$$10 \text{ dB} = 10$$

$$+10 \text{ dB} = \times 10$$

$$+ 3 \text{ dB} = \times 2$$

$$+ 3 \text{ dB} = \times 2$$

$$+26 \text{ dB} = 400$$

What is the numerical ratio of -14 dB?

$$-10 \text{ dB} = 1/10$$

$$-10 \text{ dB} = \times 1/10$$

$$+ 3 \text{ dB} = \times 2$$

$$+ 3 \text{ dB} = \times 2$$

$$-14 \text{ dB} = 1/25$$

What is the numerical ratio of -185 dBw? As you have probably noted this will be a very small number roughly equivalent to the sensitivity of a moonbounce receiver on 432 MHz and represents the receiver input level as compared to 1 watt. Again referring to the table to simplify the computation

$$-60 \text{ dB} = 1/1,000,000$$

$$-60 \text{ dB} = \times 1/1,000,000 \quad \text{or } \div 1,000,000$$

$$-30 \text{ dB} = \times 1/1,000 \quad \text{or } \div 1,000$$

$$-10 \text{ dB} = \times 1/10 \quad \text{or } \div 10$$

$$-10 \text{ dB} = \times 1/10 \quad \text{or } \div 10$$

$$-3 \text{ dB} = \times 1/2 \quad \text{or } \div 2$$

$$-3 \text{ dB} = \times 1/2 \quad \text{or } \div 2$$

$$-3 \text{ dB} = \times 1/2 \quad \text{or } \div 2$$

$$-3 \text{ dB} = \times 1/2 \quad \text{or } \div 2$$

$$-3 \text{ dB} = \times 1/2 \quad \text{or } \div 2$$

$$-185 \text{ dBw} = 1/3,200,000,000,000,000,000 \text{ watt}$$

Its OK to use a calculator on this one, I did too.

If you're mathematically inclined and can use logarithms the formula to compute these ratios is:

$$\text{dB} = 10 \log_{10} \frac{P_{\text{out}}}{P_{\text{in}}}$$

or if the ratio is desired as we have been computing

$$\frac{P_{\text{out}}}{P_{\text{in}}} = \text{Antilog} \frac{\text{dB}}{10}$$

Many times we desire to express the power ratio in terms of voltage or current. When doing so it must be remembered that the dB still refers to a power ratio and is merely converted to indicate the equivalent voltage or current ratio. For instance if the signal into a receiver changes due to the transmitter power being doubled, the level of the RMS voltage into the receiver doesn't double but increases approximately by 1.414. It

doesn't double because the voltage increases as the square root of the power. Remember $P = \frac{E^2}{R}$? Since we are using the same impedance at both power levels, when the power doubles the voltage goes up by $\sqrt{2} = 1.414$. Many of us misuse the dB when expressing it in terms of voltage or current by not taking into account the different impedance levels of the points of measurement. Such a case would be the gain of an operational amplifier. The input impedance may be several thousand ohms or more and the output impedance only ten or so ohms. If the voltage gain is 100,000 the gain in dB is not simply

$$\text{dB} = 20 \log \frac{E_{\text{out}}}{E_{\text{in}}}$$

$$\text{dB} = 20 \log \frac{100,000}{1} \neq 100 \text{ dB} \quad (\text{in this case})$$

the correct formula to obtain the gain in dB must take the impedance levels into account. These formulas are correctly stated as:

$$\text{voltage dB} = 20 \log_{10} \frac{E_{\text{out}}}{E_{\text{in}}} + 10 \log_{10} \frac{R_{\text{in}}}{R_{\text{out}}}$$

$$\text{or current dB} = 20 \log_{10} \frac{I_{\text{out}}}{I_{\text{in}}} + 10 \log_{10} \frac{R_{\text{out}}}{R_{\text{in}}}$$

Only when the two resistances (impedances) are equal can we omit the second terms of the equations.

$$\text{voltage dB} = 20 \log_{10} \frac{E_{\text{out}}}{E_{\text{in}}} \quad \text{across equal impedance}$$

$$\text{or current dB} = 20 \log_{10} \frac{I_{\text{out}}}{I_{\text{in}}} \quad \text{across equal impedance}$$

In conclusion decibels are not difficult to work with. Remembering only two easy ratios, all whole number ratios can be computed mentally. By being able to convert dBs into numerical power ratios a better "feel" can be had for the expected levels of receiver sensitivities, amplifier gains, and effective radiated power of antennas.

Ray AAØL

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GRID-DIP METERS (Part III)

What are some additional applications for a grid-dip meters for the ham. This month we'll talk about Series and Parallel (Shunt) trap adjustments.

Parallel traps can be checked without modification of the trap. Series traps, however, must be reconnected so that the L (coil) and C (capacitor) are in parallel. Once the reconnection is done the traps can be adjusted.

Using the grid-dip meter as described in parts I and II for coupling the coil under test to the meter coil, find the resonant frequency of the trap. Should adjustment be necessary to bring the trap to the desired resonance, add or subtract L or C until resonance is achieved.

Some traps have adjustable components. If the trap you are attempting to adjust does not, changing capacitors or coils will do the same thing. Capacitor changes are usually much easier but caution must be exercised in choosing a new capacitor with a working voltage comparable to the old one.

Once desired resonance is achieved and your trap is a series trap, merely reconnect it in series and you are ready to go.

In part IV we'll discuss another application of the grid-dip meter.

73's, Doug WBØMHP

FOR SALE

Immaculate Heath 300/401. Excellent working condition.
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4

The annual general membership meeting of the Pikes Peak FM Association (PPFMA) was held on the second of March 1980. The primary subject on the agenda was election officers and board members. This was accomplished and all vacancies filled even though attendance was far below that expected. Those who did not attend missed a very interesting and informative program highlighted by a technical briefing on the 37/97 machine by Barry, NØKV; an update on the status of the 16/76 machine by Keith, KØYXC and Larry WBØJGC; a talk on SERVCOM by Bud, WBØTIB and a talk on civil defense by Bill, KA4DKA. Keith and Larry had a spectrum analyzer, wattmeter and Cushman set up, testing and "setting" equipment for one and all.

For those who haven't heard, a contest for a PPFMA logo is in progress, with very little progress so far. The prize for the winning design is one year membership. Get some good ideas in to any board member and let's come up with a distinctive logo.

The new SERVCOM manager will be WAØCYM, Don; at least until Bud, WBØTIB finishes his new house in Black Forest. Any changes in your status, new call, address, equipment or whatever should be addressed to Don on the air or to P.O. Box 7877, Colorado Springs, CO 80933. The same applies to anyone requesting information on SERVCOM.

Speaking of managers — Warren, WØYNE is the new site manager for 37/97; Keith, KØYXC is still manager for the 16/76 site. All on-site activities will be coordinated and/or supervised by these managers.

The following public service items were received since the last issue of Ø Beat. Please call this type activity in to Tom, NØBZ for the repeater log and this column.

On February 14, Dennis WBØYKH called in an accident on 37/97 to Bud, WBØTIB who reported it to the Colorado Springs Police Department (CSPD).

On February 22 the 99/39 machine was used to coordinate a rock rescue. Don, KB5KD; Tom, WAØQQT and Mike, WBØKKI participated in the rescue.

On February 20 Dennis, WBØYKH reported a traffic accident using 37/97. Rob, WB2ZLH relayed to the CSPD for Dennis. There were no injuries, however a wrecker was required. Dennis remained at the scene to assist the police and wrecker crew as necessary.

On February 29 Pete, WBØJUW reported an auto off of I-25 south to Rob, WB2ZLH on 37/97, a wrecker was also required for this one. Rob handled the relays between Pete and the CSPD.

On March 6 WØBXM reported an accident at Bijou and Academy Blvd., Colorado Springs to KBØKQ on 37/97 who made the necessary calls to CSPD.

During the snow storm on March 16 Jim, KBØKP did an outstanding job on 37/97 of assisting motorists and providing up to date weather information to all. Thanks Jim.

73
WØMBZ

PLEASE NOTE:

The Pueblo Ham Club 34/94 repeater has been changed over and is now operating on 19/79!

Respectfully Submitted,
Charleen WBØYOB

The board was called to order by Don Lohse KBØKQ at the home of Don and Joyce Lohse at 7:30 P.M. on March 3, 1980. Information has been received that an alternate location or date may be needed for the Swap Fest. The hanger we requested may be needed April 27 to Marshall supplies for a SAC Operation. The Pikes Peak F.M. Association has accepted the responsibility for the food concession at the Swap Fest. Frank Freiler WBØPAJ reported on the delivery of Ø Beat to the various Radio Shacks and other electronic supply outlets such as Centennial, Walker, AES, Burslein-Applebee in the Citadel, and a copy to the U.S. Forest Service office. It was suggested that a friendly reminder go out to people who forgot to pay their dues so that they may resume receiving Ø Beat and other club privileges. The cost of Ø Beat was less due to the plan to have members collate and staple the issues at breakfast. Field Day was discussed and Dave Vierling NØDV said he intended to set up the organization differently this year. The committee will be organized for each station and the committee will be responsible for getting the equipment and shelter for its station. Still need to obtain the permit from the U.S. Forest Service. Frank Freiler WBØPAJ reported he had talked with Baaron Pittenger about having a club station at the QTC and found him enthusiastic about it. Mr. Pittenger sent a memo to Mr. Robert Kane concerning the club station, but has received no reply. Still no decision has been reached on Olympic Games alternate site or the Sports Festival being here. The amateur radio display is on for sure on May 3 and 4 at the Mall of the Bluffs. The club was asked to make sure that all the participants wear identifying badges during the display. The transmitter hunt is all ready to go with registration at 2:30 p.m. and the start for 3:00 p.m. from in front of the Radio Shack in Garden Ranch Shopping Center on March 8. Lots of riders are expected. Prizes are ready. The next board meeting will be April 7, 1980 at 7:30 p.m. at the home of David Riese WBØSDW at 5102 Galley Road.

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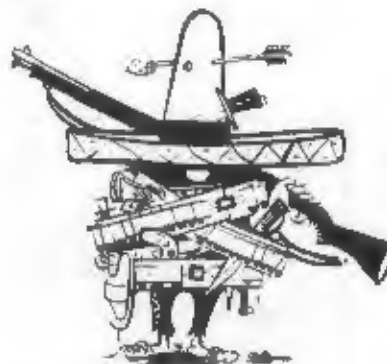
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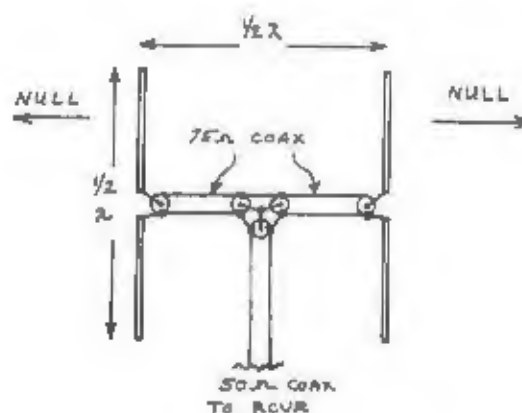
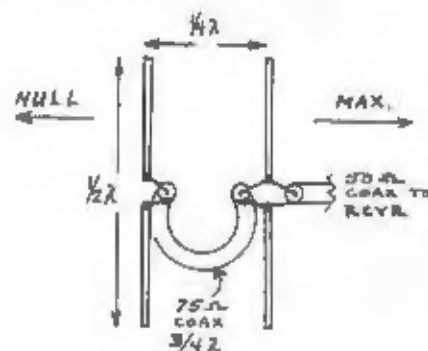
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WHAT? You forgot to pay your dues?



Two Phased Vertical Arrays For Transmitter Hunting



MEETING NOTICE

The April meeting of the Pikes Peak Radio Amateur Association will be held on April 9, 1980 at Sabin Jr. High at 7:30 p.m. Ed Means W0VO will give the program on the new Amsat Phase III and what it will take to work this newest amateur satellite. All members and any other interested persons are cordially invited to attend.

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